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ABSTRACT

The newsletter contains information about the science education activities sponsored by The British Council for the improvement of materials and practices. Areas covered include Science, Mathematics, and General. Background information along with a brief progress report is given for each of the projects described. Engineering and technology projects are described under the title General. A detailed annotated bibliography of science publications of the Council is included. A separate section includes Science Education Abstracts of papers published in journals. Brief reports of international conferences on teaching of mathematics, science, and technology are provided. (PS)

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THE BRITISH COUNCIL

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Science Education Newsletter

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ACTIVITIES IN BRITAIN - SCIENCE

1. Nuffield Advanced Physical Science (See SEN 9:4, 9:12, 12:1 and 15:2)

The publication of these books has been further delayed but they are now scheduled to be published by Penguin Education as follows:

Student's book: Workbook Vol.1 (Section 1-7) and Vol.2 (Section 8-14)	December 1972/January 1973
Teachers' Guide Vol.1 (Sections 1-7) and Vol.2 (Sections 8-14)	February/March 1973
Introduction and Guide	January 1973

There is still no fixed date for the publication of the students' and teachers' book 'Options', but it is possibly in March 1973. Further details of the publications can be obtained from Penguin Education, Harmondsworth, Middlesex.

2. Nuffield 16+ Science

A Nuffield curriculum project to develop science based materials for use in the general education of students remaining in full time education beyond the age of sixteen but not following advanced level courses.

2.1 The new sixth-former

In Britian more and more boys and girls are staying on in schools and Colleges of Further Education beyond the school leaving age without having higher education in mind. There are at least 70,000 pupils in our sixth forms who are not attempting advanced level work and a similar number in the FE sector. All the evidence is that the numbers are growing. They may want more time, or better qualifications before beginning work. They may be unsure of their motives for staying on. This project aims to identify the needs of these pupils and to produce science based materials for their courses.

2.2 Why science?

Breadth and balance are essential features of any curriculum which sets out to provide a liberal education and we believe that a curriculum which does not include science based studies cannot claim to be either broad or balanced. Everyone needs a certain amount of scientific information, but more important is a grasp of the basic skills and attitudes which can be summed up as "the scientific way of doing things".

2.3 The 16+ Science Project

The project intends to produce science based materials which will help teachers to design one year programmes for the 'new sixth formers'. Units of work will vary in size from a few hours' study to topics lasting a term or more. Sometimes the student will be encouraged to learn by himself from "self-tutoring" materials and at other times he might join a team working on a larger topic. Real and simulated problems will be tackled which will take the pupil into the community outside school.

2.4 The Project and the Community

The students will wish to use their time in the sixth form to increase their knowledge of the adult world and their prospects in it. This is a reason for

involving the community outside the school closely with the project. We propose an approach in which key local figures from Further Education and industry together with such people as local scientists and engineers are committed to the project in a practical way.

Further information and background is presented in a Working Paper "Nuffield 16+ Science" which can be obtained from the Project Headquarters or any team member.

Project addresses:
1 Headquarters - Education Section, ICI Ltd, Millbank, London SW1P 3JF
2 and Nottingham College of Education, Clifton, Nottingham NG11 8NS

Team in London: R A Finch and Sister M Hurst
Team in Nottingham: D H Fox and C A Gilbert

3. Schools Council Environmental Studies Project 5/13 (See SEN 19:4 and 14:9)

Two further publications from this project are now available. They are:

"Starting from Maps" price £1.50
"A Teacher's Guide" price £1.00

A further publication "Starting from Rocks", price £1.50 will be available shortly.

The Teacher's Guide is a particularly valuable book for anyone intending to use the environment as a stimulus and centre of attention for education work. It is divided into four sections:

The Nature of Environmental Studies
The Potential of School Environments
The Skills of Environmental Studies
Environmental Studies and the Teacher

Two Appendices contain useful addresses for teachers of environmental studies and a bibliography.

The material used for illustration purposes and for detailed description is naturally taken from United Kingdom surroundings. However the principles involved are clearly discussed and extrapolation to other environments by experienced teachers should present no insuperable difficulty.

4. Banking Biology Questions

A new study of item banking biology questions has been commissioned by the Schools Council and is underway at the National Foundation for Educational Research. A team of teachers are attempting to compile and try out a series of objective type questions and also to investigate the possibility of banking essay type questions, and their marking schemes. The item bank aims at collecting all items which have been analysed positively in terms of facility and discrimination values. With a retrieval system it will be possible to select valid items to test specific parts of the curriculum and specific objectives.

The results of such a programme could lead to a reduction in the use of untried items, especially by schools using CSE mode 3 examinations, and an increase in validity. But perhaps most important is the possibility of feedback to curriculum developers about the effectiveness of their new styles of teaching.

5. Professor of Biological Education - University of Bath

The most recent addition to the small but growing group of Professors of Science Education in the United Kingdom is Professor W H Dowdeswell. Professor Dowdeswell has just become Britain's first Professor of Biological Education at the University of Bath. Professor Dowdeswell has been associated for many years with the work of the Nuffield Foundation and was involved first in the production of Nuffield Biology O level materials and more recently in the inter-University Biology Teaching Project. Professor Dowdeswell will be well known to many biology teachers and educationists overseas.

6 Schools Information Centre on the Chemical Industry (See SEN 14:22)

The Centre has now been in operation for nearly two years, having commenced its operations in October 1970. The original aims of the Centre were to collect and collate information on the chemical industry and to disseminate this information. The original Director of the Centre, Dr Malcolm Fraser, has now been appointed to the Chair of Chemical Education at the University of East Anglia but will remain an adviser to the Centre. The new Director of the Centre is Dr P Owston, newly appointed Head of Department of Chemistry at the Polytechnic of North London. The Centre is now in contact with a wide variety of industrial organisations in the United Kingdom and has developed a considerable list of publications, details of which are given below.

The second Annual Report of the Centre was issued in July 1972 and the Bulletin appeared for the fourth time in July 1972. This issue of the Bulletin contained articles on Plastics, Pollution, Leather and Gas as well as drawing attention to new catalogues and to exhibitions at the Science Museum. A fairly lengthy article on Hydrogen Peroxide was a major feature of this issue. Enquiries should be addressed to the Information Officer, Dr B Haines, School Information Centre on the Chemical Industry, The Polytechnic of North London, Holloway Road, London N7 8DB.

Publications

6.1 Bulletin - produced three times a year.

6.2 Information booklets - these contain a list of references, together with production figures and uses:

Chlorine	(4 pages)
Steel	(7 pages)
Sulphuric Acid	(4 pages)

6.3 Information Sheets:

Domestic Gas - gives composition of natural gas and sources of domestic gas.
The UK Chemical Industry - brief description of industry and comparison with other major industries.
Pollution - journals dealing with topic - addresses for further information - general references.
Food Technology - list of recent publications.
Synthetic Fibres - list of recent publications.
The World's Chemical Industries - list of recent references on the economics of foreign chemical industries.

6.4 Visual Aids from Industry:

Wallcharts - a list of more than 100 wallcharts and where they may be obtained. Subject index.

Films - companies who are willing to supply films for school use.

6.5 Reprints - main article from each Bulletin:

Ammonia (7 pages)	- No.3 March 1972
Hydrogen Peroxide (8 pages)	- No.4 July 1972
Nickel (8 pages)	- No.1 July 1971
Sulphuric Acid (7 pages)	- No.2 November 1971

6.6 Others:

The Manufacture of Leather (15 pages) - describes the preparation, tanning and finishing of leather.

7. The Chemical Society Education Division

The first Newsletter for the members of the Education Division was published in September 1972. Seven of the nine Chemical Society regions in Britain now have active Education Division Committees and it was felt important that there should be good communication with the members. It is therefore planned to produce a Newsletter 3 times a year which will give information from the various regions as well as general information. In this Newsletter it mentions overseas members and states that the latest figures show that the Division has over 800 overseas members. The Council of the Education Division is anxious to cater for such a sizeable proportion of the membership. It therefore hopes to provide a means for keeping members informed of developments in the UK and overseas, for example as few overseas members can attend Education Division meetings and symposiums it is planned to offer reports with the original papers and summaries of the discussion sessions. The first of these will cover the one-day symposium on practical work to be held at the Chemical Society autumn meeting in Nottingham. Suggestions about how the Division can help overseas members will be welcomed. The Secretary will also be pleased to hear from any members who are visiting the UK and to give help in planning visitors' programmes. The address is The Chemical Society, Burlington House, Piccadilly, London W1V OBN.

8. College Curriculum Science Studies

This project was begun in the summer of 1971. It recognises the crucial importance of curriculum science studies in teacher education in Colleges of Education and asks the question "How can these courses give students an adequate foundation upon which to develop the imaginative and exciting science teaching envisaged by the primary schools science projects?" In a leaflet describing the project the Directors point out that their thinking has been very much influenced by the lack of confidence with which many students approach science. It seems that for various reasons students have often come to regard scientific ideas as ends in themselves rather than as means to understanding. Only too frequently "knowing science" has meant being able to grasp a set of "right answers". Students who have found difficulty in getting these "right answers" then experience a particular sense of failure.

In terms of what actually goes on in the classroom students appear to have two main problems:

8.1 Although they seem able to introduce the materials they then find it difficult to develop the work along the lines of objectives which they have set themselves.

8.2 They also experience difficulty in building on the more spontaneous child-centred situation such as are so well described in the Nuffield Junior Science case histories.

The Directors then go on to propose some possible solutions. They suggest that it may be necessary for students to come to see the subject as a whole in a different light. They should see science as a means of devising and testing explanations for themselves in which thoughtful scientific ideas are used but as guides to understanding rather than as ends in themselves. Also it is reasonable to suggest that the way students work in schools is influenced as much by how they are taught as by what they are taught in colleges. It becomes important therefore that the appropriate method used to train teachers should not conflict with the ones recommended for the students' use in schools. To help in this situation the project intends to produce materials of two kinds. The first of these are a series of modules which are small units of work for students consisting of 20-30 page booklets. Each unit will contain a starter activity which will include simple scientific concepts. Suggestions will be made to help make tutors aware of the possible lines of investigation that can be developed from these starting points. In addition the unit will give some guidance to help students work out explanations for the sort of observation we think children may make about these activities. And also it will contain material which will confront students with some of the practical problems of teaching, organising the classroom, suiting work to different levels of understanding, children's safety and so on. A second element in the project materials will be a statement to lecturers which will present in broad terms the project's ideas on how some of the problems of a curriculum science course might be solved, together with a description of some of the ways in which colleges are already tackling particular problems. It is intended as a way of stimulating discussion and disseminating ideas but is not intended to be regarded as a definitive statement.

The project has acquired an evaluator as part of the project's staff, the function of whom will be to study effects rather than to measure predicted outcomes. The project organiser is Mr J K Bird of Southlands College of Education, Wimbledon Parkside, London SW19 5NN. The project is sponsored by the Nuffield Foundation and the Social Science Research Council.

9. Association for Science Education

The current publication of Education and Science, November 1972 contains a note on the activities of the Science-Mathematics Working Party. The Science-Mathematics Links Working Party has as one of its objectives the publication in the relevant Associations' bulletins, of reports on projects carried out in schools involving direct cooperation between the science and mathematics department. Many such experiments must have been carried out which would be of interest and assistance to other schools if the details were made public. The current issue of Education and Science contains an interesting example of this from Mr J Williams of work carried out in Hazlewood School. Other examples would be welcomed by the Committee. If readers of SEN know of such work they are invited to communicate with the Working Party Secretary, Mr R K McCulloch, Chorlton High School, Manchester M21 2XP, England. The example quoted in November Education and Science concerns the oil drop experiment which has now become a familiar part of Nuffield style 'O' level physics/chemistry courses. An interesting analysis of the approximations which are required in order to operate the oil drop experiment is contained in the article. Education and Science is the official bulletin of the Association for Science Education and is available, price 25p plus postage, from the Association for Science Education, College Lane, Hatfield, Herts.

ACTIVITIES IN BRITAIN - MATHEMATICS

10. Schools Council Primary Mathematics Project

The Project started in January 1972 with two immediate objectives:

10.1 to get a general picture of the situation, and

10.2 to try and find out how this particular Project can help in the improvement of mathematics education in primary schools.

Obtaining an impression of the scene by going round talking to teachers, mathematics advisers and so on was not too difficult; but discovering how teachers might best be assisted has been more elusive. The Project has now produced an initial bulletin called "The first six months" in which it surveys firstly the overall picture and secondly looks at the problem of helping teachers.

In the overall picture the bulletin comments on the gentle swing back in the last three or four years in terms of both content and method and suggests as a reason the fact that children are being hampered by weaknesses in their basic skills of computation. As a result there has been a renewed emphasis on the instant recall of addition and subtraction facts, on learning tables and so forth and where some schools were concerned to do everything individually or in groups, there is now a recognition that class teaching and class discussion have a place. It concludes that a certain re-emphasis on such skills seems to be no bad thing, so long as it is recognised that "knowing your tables" is not an end in itself. It suggests, however, that this movement should not be allowed to get out of hand and it points out that the students now emerging from colleges of education and universities will have been brought up on SMP or Nuffield materials and will not wish to revert to traditional-type content. One characteristic that emerged clearly in visits to schools was the way in which a mixture of methods is now being used in many schools. Many LEAs now have outline syllabuses for mathematics or have working parties preparing one and a large proportion of these schemes of work have their origins in the Nuffield guides and the courses of Miss Biggs, HMI. Mathematics in primary schools is, of course, in a different position from maths in secondary schools. By and large secondary school mathematics is taught by mathematicians who have therefore a commitment to their subject, but the great majority of primary maths is taught by non-specialists. An additional problem is that, compared with most other subjects, maths is abstract and hierarchic, each step building on the previous one. Hence maths is particularly dependent on the teacher and very vulnerable to bad teaching. This introduces the question of how can teachers be helped. The report sets out ten possible ways in which teachers might receive some assistance in this field, ranging from a survey of the various schemes of work, a listing of published materials, the construction and validation of a question bank, the identification of significant features of teaching style and so on. The Project aims to go on searching for other ways in which teachers may be offered guidance. Bearing in mind that few primary teachers are maths specialists, we must find means of increasing teachers' awareness of the possibilities of the subject. The note concludes that any suggestions as to lines of investigation that are likely to be effective for providing practical help to teachers will be most welcome.

The Project Director is Professor J Wrigley and the Research Officer is Mr M Ward at the University of Reading School of Education, London Road, Reading RG1 5AQ.

So far the Project has available on request four items, a list of local schemes of work, a draft frame-work of content and concepts, a draft topic analysis suitable for 10-year-olds and a pilot study questionnaire.

11. School Mathematics Project (See SEN 18:18)

11.1 The report on the conference held in Birmingham in April 1972 on Mathematics in the Middle Years of School is now available. In the foreword to the report Dr Bryan Thwaites, Director of SMP, after giving a brief resume of the reason for the innovation of SMP during the 1960s, goes on to say: "The background in 1972, however, is remarkable for its difference from that of 1961. Now secondary schools are increasingly non-selective and as a consequence organised on the basis of unstreamed classes; setting for subjects is giving way to the interweaving of traditionally separate subjects; the generalist teacher is moving into pupil age-groups previously staffed by specialists; many kinds of hardware - such as over-head projectors, film projectors and tape recorders - are available which were hardly used 10 years ago; the great variety of software too often bewilders the teacher more than helps him; and finally there is a sense of radical change pervading the entire educational system....

It is against this new, challenging, yet in many ways disturbing background that the SMP is now directing its attention to the area of the so-called Middle Years. that is, ages 8 to 13, for it is in this area that the problems briefly outlined above seem to combine in their most acute form."

The first part of the report deals with the conference objectives, written by A R Tammadge, Headmaster of Sevenoaks School. He says: "The Steering Committee of the Birmingham Conference had two principal objectives in mind. The first was the need to explore the present situation in the teaching and learning of mathematics in the middle years and the tasks that lie ahead if they are to be improved; the second was to bring together people who might undertake these tasks and we hope to act as a catalyst that will trigger them into thinking and planning. We saw the eventual outcome in the shape of mathematical materials for children and their teachers. The method adopted was that used at the Southampton Conference in 1961. Essentially it consists of Total Immersion. The participants were carefully chosen either from personal knowledge or recommendation or after scrutinising what was meant to be a self-revealing application form. We got the people we needed! Nearly 120 agreed to come; unfortunately a number of others had to be turned away. Most had plenty of bees buzzing in their bonnets and were articulate and self-confident enough to allow them to come out and buzz in public."

The report is more or less unedited work of the groups into which the conference divided and it is published in the hope that it will contribute usefully to the national discussion of the mathematical needs of the Middle Years. The report is given under the following headings:

Mathematical objectives: the Middle Years
Foundations for the Middle Years
Curriculum for the Middle Years: Number
Curriculum for the Middle Years: Space
Curriculum for the Middle Years: Structure - algebra - logic
Curriculum for the Middle Years: Measures - statistics - computing
Mathematics applied
Training and deployment of staff
Organisation, records and assessments
Learning mathematics
Resources
Rooms, furniture, facilities
Middle Schools

Copies of the report may be obtained from the SMP Office, Westfield College, Hampstead, London NW6.

11.2 "School Mathematics Project - The first ten years" This publication which has been edited by Professor B Thwaites, is primarily a collection of the Director's reports for the Project for the years 1961 to 1971, and is produced by Cambridge University Press, price £1.50. In addition to the reports issued from 1961-1972 the book contains 2 articles, one on the mathematics of the School Mathematics Project by Mr D Quadling and the other on SMP and Curriculum Development by Mr T Wheatley. The syllabuses for the SMP GCE examinations are also included. This is a very useful professional survey of the work of the SMP to date.

12. Scottish Mathematics Group (See SEN 18:19)

The second Newsletter entitled Modern Mathematics Newsletter published for the Scottish Mathematics Group by Blackie & Son, and W & R Chambers (see SEN 18, 19:3) was distributed in February 1972. This Newsletter recalls the background and general aims of the re-appraisal of modern mathematics for schools. It includes a section which details the new distinctive features about the course including the new grading of the series, the new feature in chapters on computer topics from book 4 onwards and also the six year books. Copies of this Newsletter are available from either Blackie, Bishopbriggs, Glasgow or Chambers, 11 Thistle Street, Edinburgh, EH2 1DG.

13. Fife Mathematics Project

This Project, which concerns itself with the development of ideas in mathematical education, is centred at the Department of Education of the University of Stirling under the direction of Mr Geoffrey Giles, Lecturer in Education. In the last academic year the Fife Mathematics Project was in operation with 28 first-year mixed ability classes in 8 schools and in 1972/73 this number is expected to rise to 120 classes throughout all but three of the Fife secondary schools. The philosophy of the project is based on the following propositions:

Children work well when they are personally involved in what they are doing.
Children are more involved in activities they have freely chosen.
Children enjoy being active and involved.

If a teacher is to be judged by what his pupils learn, it follows that in addition to class teaching it would be extremely valuable to have the pupils enjoyably involved in the activities they have chosen, provided these activities lead to deeper understanding and insight of mathematics. The project therefore attempts to incorporate considerable freedom of choice; material designed to stimulate; the use of equipment whenever appropriate; an emphasis on learning by absorbing and personal involvement of the pupils.

At present 20 work-card booklets together with associated worksheets and equipment have been developed in close association with teachers and pupils. Each booklet contains 8 work-cards and a post test. While some of the booklets form sequences, as a whole there is no fixed order of difficulty. No attempt has been made to cover the syllabus and the aim is to present enjoyable and stimulating situations through which the pupil can absorb fundamental concepts, notations, languages and skills. The sole test of the material is whether or not this happens. The major advantage of the project is said to be that it takes no responsibility away from the teacher: it is he who has to decide how much individual work to allow and what material to make available. This means that he can proceed as fast or as slowly as he

wishes in changing his methods of teaching.

That pupils enjoy the project is to be expected: that teachers prefer working in this way is encouraging. But the continual development of new ways of working is not enough. It is essential that a critical examination be made of these new ways of working. For this purpose, therefore, the Scottish Education Department has awarded a grant to finance a three and a half year research project in the learning of mathematics which is being carried out at Stirling University. The senior Research Fellow in the team is G Sampson. The objectives of the project will be:

13.1 The development of concepts and models of a better description of the observable internalised processes involved in learning mathematics.

13.2 The study of the effectiveness in school use of experimental material.

13.3 A clearer understanding of the mechanisms that promote mathematical activity and facilitate mathematical learning and the development of a range of catalysts appropriate for classroom use. In the theoretical research it will be taken as an initial working hypothesis that a pupil's attitude to mathematics is a major factor affecting his attainment and potential. In the rest of the project it will be assumed that a positive attitude is desirable.

14. Continuing Mathematics Project, sponsored by National Council for Educational Technology (NCET)

The Continuing Mathematics Project was set up in the University of Sussex in August 1971, sponsored by the National Council for Educational Technology. It is financed for four years by funds from government and industrial sources. Its purpose is to develop a flexible system of largely self-instructional materials to promote the continued study of mathematics by students in sixth forms and elsewhere whose main studies do not include mathematics. In the preparation of materials special consideration will be given to students whose principal interests lie in subjects such as economics, geography or biology or who are looking towards a career in business or teaching. The units produced will be suitable for study by any students who have followed a normal mathematics course up to the age of 15 or 16 with moderate success typified by a bare pass at Ordinary level in GCE or a good grade in CSE. A modular construction will provide the required flexibility.

The learning materials will be designed for use by students without constant access to specialist teachers of mathematics since there are not enough of these. In the later stages of the Project support materials to assist non-specialist teachers will be added. Programmed texts will provide the main output reinforced by audiovisual products where these have advantages to justify their extra expense. The need to keep costs down to a level within the normal budget for the maintained secondary school or sixth form college will dominate the choice of learning media.

14.1 Motivation

The Project team is probably more concerned about this aspect of their task than with any other. Four lines of approach are to be integrated:

Vocational interests;
Multi-media resources;
Individual learning rates and routes;
Involvement techniques.

14.1.1 Vocational interests These will be invoked in the first instance by the provision of optional sections at the ends of units rather than alternative introductions of completely different units. After the initial course chosen to suit himself a student may continue with more specialised studies which will generally assume a stated acquaintance with topics dealt with in a Foundation Course.

14.1.2 Multi-media resources It is expected that besides booklets, workcards and kits of apparatus for experiments or investigations these will contain slides, tapes, tape/slide presentations and film loops for individual or group use.

14.1.3 Individual learning routes When the materials are fully developed flow diagrams and careful descriptions of units will assist students and teachers to make appropriate choices. Pre-tests, as well as forming a basis for assessment by post-tests, will indicate a student's readiness for, and need of, any unit in his route to a selected goal. (In the early years of the Project the necessity for full and extensive validation may require some reduction in the degree of flexibility that is intended ultimately.)

14.1.4 Involvement techniques Discovery methods, experiments and the use of simulated situations to induce interest are not easy to incorporate in self-instructional material. This is the most experimental aspect of the Project and members of the team hope to improve with experience. Not all the innovations to be tried are likely to succeed. Teachers who know the students and their environment will probably be the main source of effective contribution to this problem and feedback from them is vital.

14.1.5 Time considerations A position has developed from on the one hand the need to relate mathematics to outside topics that may more readily interest the students and on the other the need to ensure that each student is conscious of definite measured progress along the mathematical route of his own choice. Since the weighting of these two factors will vary from one student to another, wherever possible those who want and can cope with the quick route through a section of their course will be assisted in finding one.

14.2 Terminology

For convenience the production is conceived in terms of modules and units; a module is a coherent sequence of material designed to occupy an average student about 10-12 lessons of 40 minutes each: that is 7 or 8 hours work. Modules are sub-divided into units of from two to five lessons each; and some units, especially those which form the bulk of the Foundation Course described in the next section, are self-contained and not parts of modules.

14.3 Content of Initial Modules

The topics chosen for production by the Project team during the years 1971/73 are:

Probability and Statistics; Calculus; Algebra (matrices etc).

Each of these will be designed in three stages, one module to each stage; whereas stages 2 and 3 will be largely self-contained the first stage of each will be embodied in a Foundation Course. It will include units contributing to a variety of sequences. While it will be possible for a student to complete stage 1 on any topic by a selection of units from the

Foundation Course, he may need a wider basis before proceeding further (it is desirable for instance that he should have completed stage 1 of calculus before starting stage 2 of probability of statistics; and this may be a necessity until more units have been developed).

14.4 Content of Later Modules

It is intended that about 45% of the output will be created or initiated by writing teams from outside by arrangement with the Project team. This will take the form of more specialised modules, self-contained except that they may draw on knowledge dealt with by the in house production. Several topics are being considered but it will not be until the summer or autumn of 1973 that any of these productions will be ready for trials.

The Director of the Continuing Mathematics team is Mr A W Fuller MA at the University of Sussex, Falmer, Brighton and further information may be obtained from him.

15. Association of Teachers of Mathematics

The Association of Teachers of Mathematics has produced from time to time a valuable series of small booklets on practical matters in mathematics teaching. One of the more recent of these is called 'Sticks - A collection of ideas for teachers'. The aim of this particular publication is to present a collection of ideas and starting points for the primary and secondary classroom. It is written by L Baker, R Butcher, D Hale and P Wells. It is the result of a weekend meeting at Nottingham in May 1971. The sticks involved are six inches long and one-tenth of an inch in diameter, wooden, and come in boxes of 1,000 and are sold in the United Kingdom by chemists as wooden applicators. A box of 1,000 costs approximately 50p. They look like rather long unpointed cocktail sticks. The booklet then suggests various methods by which these can be joined and the patterns which can be constructed from them. A number of very interesting mathematical games for children are outlined. A complete list of the publications of this kind from the Association of Teachers of Mathematics is given below. Orders for these should be sent to the Association of Teachers of Mathematics, Market Street Chambers, Nelson, Lancashire, BB9 7LN, England. Orders should be accompanied by the cash required and for overseas people postage should be included.

Switch Boards and Logical Paths	£0.30
Development in Mathematical Education	£0.40
Film Pamphlet 1 (Film list 1968)	£0.18½
Film Pamphlet 2 (Films and Film-making)	£0.16
Pegboard Games	£0.23½
Examinations and Assessment	£0.57½
Symmetry Groups	£0.18½
Teaching Aids and Logic	£0.16
Topology	£0.30½
Materials for Mathematics	£0.05
Mathematics History - a select bibliography	£0.05
Sticks	£0.28½
Geoboards	£0.20
Turning the Tables	£0.20
Numbers Everywhere	£0.20

NOTE: The last three items are duplicated publications and stocks are limited.

ACTIVITIES IN BRITAIN - GENERAL

16. Design and Craft Education Project

This was formerly known as the Research & Development Project in Handicraft and is supported by the Schools Council. The centre of emphasis has been on the consequences of work in a wide range of materials for the education of young people. The Project is sometimes popularly known as "Education through the use of materials".

The Project works directly with teachers and pupils in a range of schools in Cheshire, Hertfordshire, Leeds, Leicester, London, North Wales, Staffordshire, the West Riding and Wiltshire and is closely associated with schools in Northern Ireland and BFES (Germany). Each area has an Area Co-ordinator appointed by the respective Education Authority.

The features of the programme have been the stress on aims; at all times attempting to identify the future needs of young people in a rapidly changing society and with particular reference to the raising of the school leaving age. The growing awareness that teachers cannot always work in isolation within subject compartments has been highlighted by much of the Project's activity. Not only has there been co-ordination across the materials of subjects but also with the humanities and sciences.

In all aspects of the programme the "design" approach has been applied in a variety of problem-solving situations ranging from basic design activities to complex material problems in an attempt to demonstrate the intellectual challenge and social implications of work with materials. The wide range of activities springing from this approach has taken pupils into the wider community beyond their school environment; to other schools, colleges, hospitals, factories, theatres and ancient monuments. The work in and out of school is related to three-dimensional adult activities in the home, work, leisure and community activity.

The teaching materials devised during Phase I of the Project will form the basis of a series of publications to appear in the next two years, much of it in association with public authorities, professional and trade associations, industrial and community groups. These will consist of teachers' booklets and a range of support materials. Each term the Project publication 'Survey' reports on some of these activities in the schools. Copies of 'Survey' may be obtained from the Secretary, Design & Craft Education, Department of Education, The University, Keele, Staffordshire ST5 5BG. The annual subscription costs £0.50.

At present the Project is in Phase II, which covers continuation of development work in design and craft education, publication and diffusion of teaching materials, the development of examinations emphasising design and problem-solving approaches.

17. Manchester & Region Centre for Education in Science, Engineering & Technology

This is the latest Regional Centre which has been established to promote and advance science, engineering and technology education in an area comprising the south east parts of the County of Lancashire and the north east parts of the County of Cheshire. The Centre aims to provide a link between those in schools, further and higher education, local education authorities, Government Departments, science centres, scientific societies, industry and professional associations who have an interest in science and engineering and technology education.

Its principal aim is to strengthen and extend the services available to those concerned with education in science, engineering and technology subjects. In pursuing this aim the Centre will seek to provide:

- a service to co-ordinate the many activities aiming to further the teaching of science, engineering and technology subjects;

- a focal point for information, assistance and guidance flowing in both directions between industry, further and higher education on the one hand and schools on the other;

- a means of collecting and disseminating information of value to teachers;

- a means of promoting a wider understanding of the activities of scientists, engineers and technologists; of promoting a wider understanding of technological problems and the significance of technology in society;

- a means of preserving among teachers the momentum engendered by curriculum development and of encouraging initiative and inventiveness among young people.

The co-ordinator of this new Centre is Mr David McCormick who has had wide experience in education both in this country and overseas. The Centre is based in the John Dalton Faculty of Technology, Manchester Polytechnic, Manchester.

18. The National Centre for Schools Technology

The National Centre is now an established fact. (See SEN 19:19.) The staff of the new Centre will be the Director, Mr Geoffrey Harrison who is Head of a new Department at Trent Polytechnic comprising the National Centre for Schools Technology and the Centre for Studies in Further and Higher Education. The Deputy Director will be Mr Glen Viles, who has been the Project Technology Deputy Co-ordinator. In addition Alan Marshall, previously the field Director of Project Technology and now working with the Open University post-experience course on technology for teachers, will be working with the National Centre for two days a week. He will edit 'Schools Technology'. Other staff will be Malcolm Plant, who has been on the Project Technology team for the last two years, and Cyril Gorham who has been employed in editing and generating teaching material and was formerly at the Gateway School, Leicester. The Centre will be an integral part of Trent Polytechnic in the middle of Nottingham. The Centre will concern itself primarily with helping agents to disseminate and diffuse curriculum material throughout the country. It will also organise short and long residential courses at Trent Polytechnic and prepare model courses on the work of Project Technology. The Centre will support the Standing Conference on School Science & Technology and the Schools Technology Forum (see SEN 18:25). The essence of the National Centre will be its function as a core service unit. Initially the staff will be principally concerned with the diffusion and further development of Project Technology materials.

19. Project Technology

The following Project Technology handbooks have been re-edited and are now available at 45p each or as a pack of six at £2.25 from Heinemann Educational Books Ltd, 48 Charles Street, London W1X 8AH:

19.1 Bernoulli's principle and the carburettor. A consideration of Bernoulli's principle of fluid flow with particular reference to the carburettor.

19.2 Simple bridge structures. An introduction to structures starting with a survey of bridges in the modern world. Theory and applications are backed by examples of work from a number of schools.

19.3 Simple material testing equipment. Testing techniques involving construction of vice-type and "universal" testing rigs.

19.4 Introducing fluidics. An introduction to fluid logic and its applications. The uses of the various fluid elements are explained and a basic fluidics kit is suggested.

19.5 Engine test beds. Design and construction of an inexpensive test bed for demonstrating and investigating the characteristics and performance in engines and systems.

19.6 Gas-fired muffle furnaces. Development and the use of low-cost gas-fired muffle furnaces.

20. PUBLICATIONS

20.1 British Council SCIREFS and SCIBIBS

The Science Library of the British Council has made certain changes in the arrangement of the SCIBIB and SCIREF series. The SCIBIB series will be concerned with bibliographies of science books and journal articles on specific topics as before, together with special issues such as "British Science Books". The SCIREF series was formerly split between a group of annotated bibliographies listing British science reference materials suitable for Council and other libraries abroad (SCIREF's 1-6) and a group of bibliographies containing titles suitable for teachers and students at primary and secondary levels in various science subjects (SCIREF 7 et seq). From November onwards the SCIREF series will become solely concerned with information on Science Education material and the replacement for SCIREF's 1-6 will be issued as a SCIBIB, SCIBIB 127/72.

SCIREF 17 - A list of Physics Books for Teachers
SCIREF 23 - A list of Biology Books for Teachers

are both now available from British Council Representatives or Science Education Section of the British Council in London.

20.2 Matter and Energy, CSE General Science Book 1

Man and His Environment, CSE General Science Book 2, by N E Savage and R S Wood, published by Routledge & Kegan Paul, price: Book 1 £1.60; Book 2 £1.60.

These books are designed to follow on from the first volume in this series called 'Common Core Science' which provides a two-year course in basic science. The new volumes are intended to take the pupils up to the standard required by the CSE examination in general science. The majority of the topics required by the various GCE Boards, particularly those of the newer syllabuses, have also been covered. Parallel volumes are 'Chemistry', 'General Plant & Animal Biology', CSE Biology Book 1, 'Human Biology & Hygiene'; CSE Biology Book 2 and Physics (in two parts). Chemistry and Biology volumes are already available and the Physics volumes will appear later. The books in this series use the modern approaches to science teaching for secondary and middle schools. The accent is placed on student experimentation and upon the student's experience. Many of the experiments are capable of being carried out with the minimum of equipment and SI units have been used throughout. A particularly valuable feature is the extremely clear and well-drawn diagrams.

20.3 Towards Numeracy

This was a supplement to "Education" published to mark the second International Congress on Mathematical Education. The contents include an article by Mrs Elizabeth Williams entitled 'Extending the Ladder from Primary School', an article by A G Howson 'The Next Priority - Teaching the Teachers', 'Computers - Roads for Research' by P J Barker and 'Mathematics Suit, Order One Now' by Laurie Buxton. The Supplement is published by Councils & Education Press, 10 Queen Anne Stredt, London W1M 9LD.

20.4 Nuffield Mathematics Project Checking Up II, published by J Murray and W & R Chambers, price £1.05

This is part of the third category of books in the Nuffield Mathematics Project and as the name implies, provides check-ups on the children's progress. The traditional tests are difficult to administer in the new atmosphere of individual discovery and the intention of the project has been to replace these by individual

checkups for individual children. These have been prepared by a team from the Institute Des Sciences de l'Education in Geneva under the general supervision of Piaget. These check-ups together with more general commentary are issued in the same format as the other guides and are in fact an integral part of the scheme.

This particular volume is in parallel with Checking Up I and deals with shape and size concepts for children of roughly ages 5 to 8 or 9, although some of the summary check-ups at the end would extend to older children. An important emphasis of this part of the work is on measurement with its necessary approximate nature, whereas Checking Up I leads to the 'counting numbers". These check-ups are intended to be flexible and only for the guidance of the teacher and the material can be adapted for individual purposes.

20.5 Chemical Nomenclature: Symbols and Terminology for Use in School Science, The Association for Science Education, price £0.75

This is a report prepared by a Working Party of the Education (Research) Committee of the Association for Science Education. For many years teachers and pupils have been confronted with the transition from traditional to modern chemical nomenclature. This report is an attempt to rationalise the position at school level. In common with the earlier report on science symbols and abbreviations, the document represents a considerable amount of effort on the part of the members of the Working Party. The report covers an introduction to symbols, terminology and units for physical chemical quantities; an introduction to inorganic nomenclature, together with alphabetical lists of recommended names for inorganic ions and molecules etc; and an alphabetical list of common current inorganic names as well as an introduction to organic nomenclature; an alphabetical list of recommended names for organic compounds and an alphabetical list of current organic names in common use. The report concludes with a series of recommendations by the Working Party for formulae and equations.

20.6 Teacher's Guide to Assessment in Modern Chemistry, by J C Matthews, published by Hutchinson Education, price £0.75

The name of Mr Matthews will be well known to teachers of modern chemistry, particularly in the context of assessment, and the appearance of this little book is most welcome. The techniques of examination in science subjects have undergone considerable development in the past few years and these developments are reflected in the contents of the book which cover Trends in the assessment of chemistry; Objective tests in modern chemistry; Free response and structured questions; Keys and analysis of objective tests in modern chemistry and a marks scheme for problems in modern chemistry. This book will be a valuable guide to teachers wanting to cope with the more modern aspects of chemical examining and will be particularly useful to the younger and less experienced teacher who may be meeting these topics for the first time.

20.7 Structured Questions in Chemistry by A D Gazard and E J Wilkins
Objective Questions in Chemistry by K W Valentine
both published by McGraw-Hill, price £0.65 each

With questions of method of assessment of many sciences under vigorous discussion at the present time one feature of the process which has been rapidly developing in recent years has been the technique of question setting and indeed the type of questions which should be used. These two books provide interesting and valuable collections of two different type of approaches to this problem and will be valuable additions to the literature at present

available. Both books are intended for the O level age group 13-16. The multiple choice questions have five possible answers to select from and it is important to note that these questions were pretested with pupils of the appropriate age and ability range; the objective questions are said to test the following abilities:

Knowledge (recall)	19%
Comprehension	45%
Application	20%
Analysis/Evaluation	16%

The questions are divided by subject matter rather than by difficulty or by any other means. The structured questions consist largely of sequences of questions arising out of experimental situations with which the student should have become familiar.

20.8 Chemistry: Facts, Patterns & Principles, W R Kneen, M J W Rogers and P Simpson, Addison Wesley Publishing Company, price £3.25

This book is aimed at the student starting on an A level course but it is by no means confined to introductory A level style material. The book should continue to be useful well beyond that level. It is an outline of facts, patterns and principles which could provide a basis for a wide variety of courses. Emphasis has been put on understanding, but the understanding of patterns in chemistry requires a certain breadth of knowledge and a wide range of factual material has been given from which a student may select as appropriate. The book begins with an introduction entitled 'What is Chemistry?' and goes on to deal with the Mole concept, atomic structure, the structure of solids, liquids and gases, structure and bonding, energy. It deals with gases, solids, liquids and solutions in equilibrium, energy in chemical change, equilibria, rates and mechanisms of reactions, solutions and acid-base equilibria, followed by chapters on periodicity in chemistry. This is followed by sections dealing with the main groups of elements in the periodic classification and a section covering hydrocarbons and their derivatives based on the study of functional groups. A number of valuable appendices cover the covalent bond; further aspects of bonding and structure; aspects of entropy and further aspects of chemical energy. This is a useful addition to the literature available to the student of Advanced level chemistry and much of the information in the factual content is tabulated or presented in diagrammatic form to make the relationships between the various sets of data clearer and more easily understood. A series of problems are included in various chapters for the pupil to test his mastery of the material. A general bibliography is included at the end which will provide extensive background material for the student who wishes to pursue this material in greater depth.

20.9 Chemistry: A New Course for CSE, M K Bowker, McGraw-Hill, price £1.50 (Pupils' edition) (Teachers' edition £3.00)

The purpose of this book is to supply CSE candidates with amplification, clarification and revision of work done in class, to provide some relief from the tasks of note making and drawing and to act as a laboratory manual. It is intended that the book should prove useful for early years of a GCE course. The links between chemistry and everyday life have been emphasised throughout the book and this is immediately apparent in that Chapter I is entitled 'How Chemists Work'. Subsequent chapters look at Water, Oxygen and Burning, Simple Atoms, Carbon, Fuels, Flames and Energy, Acids, Metals, Detergents, Plastics, Nitrogen, Sulphur and Chlorine and return ultimately to the theme of applied chemistry with a chapter 'Chemistry All Around Us'. The diagrams are particularly clearly laid out although rather small on occasions, but a good attempt has been made to make the material as interesting as possible and as relevant to the pupils' situation. The integration of experiments with the text means that the book can be used as a class text and manual as intended. The material is differentiated by colour of

print so that the experiments can be identified easily. It will be a particularly useful book for the less experienced teacher. The book is available in pupils' and teachers' editions. It is part of the Secondary Science Series published by McGraw-Hill Ltd.

20.10 "Entry to Chemistry Courses at the Tertiary Level - A preliminary Survey"

The Royal Society in May 1972 published the Preliminary Survey to assess students' previous knowledge of chemistry as they enter into tertiary education in Britain. It was felt that if more detail were known on this then it would be of great assistance to teachers at the tertiary level when planning courses for their students. Copies of the pamphlet price 10p can be obtained from The Education Officer, The Chemical Society, Burlington House, London W1V OBN.

20.11 New Trends in Physics Teaching, Volume 2, published by UNESCO, 1970, price £2.70

This is a further volume in this valuable series on the teaching of the basic sciences which now comprises New Trends in Biology Teaching, Volume 1, 1966, Volume 2, 1966-67, Volume 3, 1971; New Trends in Chemistry Teaching, Volume 1, 1964-65, Volume 2, 1966-67; New Trends in Mathematics Teaching, Volume 1, 1966, Volume 2, 1970; New Trends in Physics Teaching, Volume 1, 1965-66, Volume 2, 1970; New Trends in Integrated Science Teaching, Volume 1, 1969-70.

This particular volume has been edited by E Nagy, Professor of Physics, Eotvos University, Budapest, Hungary. The contents of this volume include a wide variety of articles covering physics course content, physics laboratories, methods and media and testing in physics courses. Of particular interest will be Section 5 on some new physics courses. Section 6 comprises a selection of French abstracts on physics teaching.

20.12 Teaching School Physics, edited by J L Lewis, published by Penguin Books for UNESCO, price: United Kingdom £1.95, New Zealand $5.75, Canada $8.75

Physics teaching in schools has changed radically in recent years, particularly in the technologically advanced countries. The contributors to this book do not offer universal solutions: their aim is rather to provide a fresh source of ideas on the aims and practice of teaching physics for all teachers, particularly those involved in curriculum reform. Contributions have come from 26 countries and have been edited for this book by J L Lewis in association with the International Commission on Physics Education. The book starts off with the fundamental question 'Why teach physics?'. Views from five different countries are presented. Part 2 is about conditions for learning and discusses the nature of learning and in particular of learning science. It also surveys the stages in a child's development when physics should be taught and the problems of language in teaching physics. Part 3 discusses approaches to content and method, looking at how to teach physics and what to teach, with particular reference to developing countries. Part 4 is on physics and the secondary curriculum and looks at the importance of integration and the place of the history of science, technology, mathematics and computer education. Part 5, learning resources, contains discussions on apparatus, laboratory and audio-visual materials. Part 6 on curriculum reform details some mechanisms for reform, the role of examinations and teacher education. The appendices contain case histories of a number of curriculum development projects and comparative studies showing how key concepts are treated in different projects. 'Teaching School Physics' will be an invaluable reference work for teachers, educationists and administrators and all those involved in physics teaching. J L Lewis is the senior science master at Malvern College, Malvern, Worcestershire, United Kingdom.

20.13 The Working World of Physics, Books 1 and 2, I M L Jenkins, published by Nelson, price £0.85 each

The author describes the aims of The Working World of Physics so as to provide an understanding of the basic principles of physics and their application to real life situations. It is appropriate for use in the middle of the secondary school and the accent on the real life situations is very apparent. The books are very well illustrated both with diagram and photograph and take the matter of practical illustrations to greater depth than is common in books of this kind. SI Units are used throughout. The book covers the requirements of the various CSE Examination Boards but it would probably need supplementation for O level courses. A quick glance at one or two of the chapter headings will illustrate the accent on practical realities. Chapter 1 is called "All work and no play" and is followed fairly quickly by Chapter 5 entitled "Easy does it", dealing with machines and Chapter 7 "Pressed into service", which, as its name suggests, deals with pressure in liquids and gases applied to the service of mankind. In Volume 2, Chapter 8 entitled "Hot work" deals with the application of heat to engines of various kinds, ranging from steam engines to the Wankel rotary engine and the jet engine. The combination of this approach with the appropriate quantity of essential basic physics makes a very attractive pair of books.

20.14 Physics: Concepts & Models, E J Wenham, G W Dorling, J A N Snell and B Taylor, Addison Wesley Publishing Company Incorporated, price £3.75

This is a modern integrated treatment of physics which develops concept and model building, provides a structured basic idea, reflects the influence of modern curriculum developments, and is related to the new A level syllabi using SI units throughout. Additional features are the reference to technological applications and the inclusion of case studies of historical developments in physics. The book is divided into nine study units which reflect the process and structure of physics. Unit 1 illustrates the central theme, the process of model making; Unit 2 surveys classical dynamics and thermal physics is dealt with in Unit 3. Unit 4 applies the model making process to matter and Unit 5 introduces optical physics. Unit 6 treats current electricity and the gravitation of electric and magnetic fields of force are considered in Unit 7 where the field concept is extended to introduce Maxwell equations, electromagnetic waves and relativity. Unit 8 considers the implications of electricity for the model of matter and the final Unit, 9, is a case study of the development of man's ideas about the atom and its nucleus. This book is a most interesting attempt to develop materials for the curricula of pre-university studies in the 1970s. The book assumes that students using the text are familiar to some extent with the ideas and content of such courses as the Nuffield O level physics course and that elementary mathematics is studied concurrently. Despite this all-important concepts are developed from first principles, reliance being placed not so much on a thorough understanding of specific material as on a sound appreciation of the methods and ideas with which physics is concerned.

20.15 Physics by Investigation: Probe 2 & Teacher's Book, R W Fairbrother and C White, English Universities Press Ltd, price £0.85 (Teacher's Book £0.70)

Physics by Investigation is a course for students studying for the CSE and Probe 2 completes the subject coverage. The approach follows that used in Probe 1 and is an attempt to encourage learning by guided investigation. Probe 1 covered Atomic Structure, Heat, Electricity, Work and Forces. Probe 2 covers Wave Motion, Seeing Things, Refraction, Diffraction and Interference, Sound, Electricity, Energy and Power, Heat Energy, Alternating Currents and the maximisation of effort in a chapter entitled 'Using our efforts to best advantage'. It concludes with a chapter on Measurement and Change. The book is very well illustrated with clear diagrams and photographs and every effort has been made to make the material as attractive and as interesting as possible for the CSE pupil. Experiments are

integrated with the text and a series of questions are included which stimulate further thought by the pupils. It is important that students should have the opportunity of using as many methods of learning as possible. Their own results and experiences are usually particularly fruitful. They do, however, require careful interpretation and to help with this the series of questions has been included. More assistance will be needed and this will have to be given by the teacher during discussions about particular problems. It is important that the students should attempt to answer the questions themselves either by performing the experiments or by further careful thought. The questions have the additional function of indicating the most important things to watch for while performing an experiment. Some results may nevertheless be unexpected and the experiments should therefore be repeated several times where appropriate, say the authors.

20.16 Caribbean Junior Biology, H J Savory and M Dawson, Nelson, price £0.80

Caribbean Junior Biology is a special version of Junior Biology I and II by H J Savory. The changes have been made by a biology teacher who has had many years experience in the West Indies. The book is devoted to the observation and study of the common plants and animals found in the Caribbean and it forms the first year work of a four year course ending at O level. The approach to study has been brought up-to-date by the introduction of simple yet quantitative ecological studies which enable pupils to explore the environment in an interesting way and find out what animals and plants are living in it. Those animals which are found in such studies are invertebrates usually and simple keys are provided for identifying them.

This will be a particularly valuable addition to the books available for teaching biology at this level in the Caribbean and it is to be commended on the particularly clear diagrams and photographs which have been included. These are of particular importance in a biology book where recognition of the plants and animals concerned becomes of major importance.

20.17 Patterns and problems in world agriculture, by Waites, Wheeler and Gibbs, published by Blond Educational, price £1.50

This book is in the advanced geography series which has been written to cater for the needs of students in senior forms in secondary schools who are experiencing the exciting but exacting scientific approach to geography currently being adopted in geography courses in secondary schools. For those students in some tertiary institutions who are studying geography for the first time the series provides a comprehensive introduction to the major fields of geographic study. Special attention has been given to the selection of regional examples, maps, diagrams and photographs to provide the student with the opportunity to visualise geographic information and to introduce the essential element of reality into geographic studies. Exercises have been included at the end of each chapter to encourage the student in self-appraisal of the study completed and where appropriate suggestions for practical work including map study, analysis of statistics and field observations have been made to assist the student to a better understanding and appreciation of geographic phenomena.

20.18 Oxford Biology Readers, Published by Oxford University Press; Edited by J J Head and O E Lowenstein, price £0.20 each

Oxford Biology Readers are short monographs by leading scientists on a wide range of biological topics including genetics, evolution, molecular biology, biochemistry, physiology, ecology, marine biology, psychology and applied biology. Although most of the authors are British, overseas contributors are also included.

It is editorial policy of the series to state clearly the unsolved problems in each subject; to represent science as the intellectual challenge that it is; and, while keeping description to a minimum, to include experimental material. The Readers outline the latest developments in the subjects they cover and are extensively illustrated with photographs, electron micrographs, and line drawings, in black plus a second colour. At the end of each there is a carefully selected reading list of general books and articles, and a reference section.

The series is intended primarily for sixth formers, students in Colleges of Education and Polytechnics, and first- and second-year undergraduates, although some titles will have a much more general appeal. They will fit conveniently in a file among the student's own notes; alternatively they can be used to build up a book in which each chapter is written by an expert.

The projected number of books is approximately 80, the following titles are currently available:

1. Some General Biological Principles Illustrated by the Evolution of Man, Sir Gavin de Beer
2. Using Fungi to Study Genetic Recombination, J R S Incham
3. The Mysterious Origin of Flowering Plants, Kenneth R Sporne
4. Birth Control, Philip Rhodes
5. The Euglenoids, Gordon F Leedale
6. Diving in Marine Mammals, Richard J Harrison and G L Kooyman
7. Melanin Pigmentation of the Skin, A S Breathnach
8. The Mammalian Heart, A R Muir
9. Photosynthesis, C P Whittingham
10. Studying the Past by Pollen Analysis, R G West
11. Homology: An Unsolved Problem, Sir Gavin de Beer
12. Mycorrhiza, J L Harley
13. The Origin of Life, J D Bernal and A Synge
14. The Control of Water Balance by the Kidney, D B Moffatt
15. Phloem, F B P Wooding
16. The Nucleolus, E G Jordan
17. Human Dietary Patterns and Technological Change, R E Hughes
18. The Origin of Chordates, Q Bone
19. Mitochondria, J B Chappell
20. Control of Germination, M Black
21. Teeth, A E W Miles
22. Adaptation, Sir Gavin de Beer
23. Morphogenesis of the Shoot Apex, F A L Clowes
24. Transpiration, A J Rutter
26. Somatic Cell Division, B John and K R Lewis
27. Polysaccharides, C F Phelps
28. Primates, J R Napier
29. Mosses, E V Watson

30. Ageing Processes in Higher Plants, H W Woolhouse

31. Pollution, R W Edwards

32. Fossil Man, M Day

48. Insect Respiration, Sir Vincent Wigglesworth

20.19 Experimental Work in Biology (See SEN 18:28.3)

Three more titles in this series, written by D G Mackean and published by John Murray are now available; they are

Photosynthesis
Germination and tropisms
Diffusion and osmosis

Four more titles are in preparation, at a cost of £0.30 for pupils' books and £0.40 for teachers' notes.

20.20 European Curriculum Studies No.1 - Mathematics, by W D Hall and D Humphreys, Council for Cultural Co-operation, Council of Europe, Strasbourg 1968, free on application

This book is one of the outcomes of the Oxford/Council of Europe evaluation study undertaken by Oxford University Department of Education on behalf of the Committee for General and Technical Education of the Council for Cultural Co-operation with the generous backing of that organisation and of the Gulbenkian Foundation. The aim of the study was to compare the standards required for university entrance for various member states of the Council of Europe. This has necessitated not only an investigation of the academic secondary leaving examination in those countries but detailed comparisons of the curriculum. As the work proceeded it became clear that the study of the curriculum is of paramount interest to all countries. Countries, whether themselves highly industrialised or still mainly agricultural, can learn much from each other as to examining techniques, curriculum content and teaching method. This book deals solely with mathematics in the academic secondary school or stream and then only with the curriculum for those taking the subject at the most specialised level. The curriculum analysed is not necessarily confined to those topics studied in the last year or the last two or three years of schooling, but represents the best judgment of subject experts as to what is actually required to be known in order successfully to pass academic secondary leaving examinations. The book discusses the aims of mathematics teaching, educational objectives in examining mathematics and mathematics syllabi in the countries concerned. It also provides some comments on teaching method and on the academic secondary leaving examinations. A very useful select bibliography is included and a number of valuable appendices add detail to the matters discussed in the main text.

20.21 European Curriculum Studies No.3 - Biology, by A Saunders, Council for Cultural Co-operation, Council of Europe, 1972, free on application

This is the third series of studies connected with the Oxford/Council of Europe study of the evaluation of the curriculum and examinations. This particular study was initiated by the Council of Europe with the purpose of making a survey of biology teaching in the upper academic secondary schools in Europe, with particular reference to the most specialised courses in this subject, indicating those areas which might prove worthy of more detailed study. The work follows on in part from the discussions and recommendations of the OECD Conferences held at Vevey in 1962 and at Helleback in 1964. Four major areas of research were defined for the study: the justification for

teaching biology, the subject matter taught, the methods of teaching and the methods of assessment used. Further information on the teaching of biology at this level was gathered at a Working Party held at Strasbourg in 1968 and on a study tour of Europe in the following year. This report completes the Council of Europe study of the teaching of science in the upper secondary school. It is immediately apparent from the publication that the academic status of biology is inferior to that of either physics or chemistry. Biology suffers from the legacy of the past where it was equated with nature study. The book divides its report into the aims of teaching biology, biology syllabi, teaching methods and resources, terminal examinations, the organisation of biology courses within the academic secondary school. Some conclusions and recommendations are presented for consideration. A valuable series of appendices provides an interesting bibliography and background data to the main report.

20.22 European Curriculum Studies No.4 - Chemistry, by J J Thompson, published by the Council for Cultural Co-operation, The Council of Europe, Strasbourg, 1972, free on application

This is the fourth in the series of studies connected with the Oxford/Council of Europe study of the evaluation of the curriculum and examinations. This report refers to the study of chemistry in the academic section of the secondary school and is one of a number of such subject content studies being conducted at the present time. This publication surveys the aims of chemical education and the structure of chemistry teaching in the secondary curriculum. It devotes a considerable amount of attention to the chemistry syllabuses which are followed and to the teaching method and materials being used. An important section looks at questions of evaluation and assessment in chemistry teaching and also at the chemistry teacher himself. The publication contains a particularly valuable set of comparative tables and contains a bibliography on the aims of teaching chemistry at the pre-university level. The chemistry syllabuses of selected countries are included and an attempt has been made to adapt the taxonomy of educational objectives by Bloom to the objectives of chemical education.

20.23 European Curriculum Studies No.6 - Physics, W D Halls, P Figueroa, R J Griggs, Council for Cultural Co-operation, Council of Europe, 1972, free on application (See SEN 19:20)

This is the sixth in the series of studies connected with the Oxford/Council of Europe study of the evaluation of the curriculum and examinations. This publication in physics exemplifies the wide diversity that still exists in teaching programmes in this subject at the upper secondary level. On the other hand, current trends towards the harmonising, if not the unification of programmes can be discerned.

In the introduction, the authors say "As a subject in the school curriculum, physics may not have quite the foundation-stone status of mathematics, but it is nevertheless assured of an important place. It is the most exact and fundamental of the sciences and its historical development has played a vital part in shaping many aspects of philosophical thought."

The chapter headings of the book are: The Aims of Teaching Physics, Structure and Content of the Syllabus, Physics Teaching Methods, The Terminal Examination, The Role of Physics in the Curriculum of the Academic Secondary School and Future Trends.

The three appendices also include information on Physics Syllabuses in CCC member countries and Sample Examination Questions.

20.24 Geography in Education, a bibliography of British Sources 1870-1970, published by the Geographical Association

The aim of this volume has been to collect under one cover most British sources of information on this subject and to classify them into a manageable form. Articles have been grouped into seven broad categories in response to the needs of "geography in education" courses. The seven categories are as follows:

Geography: nature and evolution
The curriculum content and objectives of geography
Mental development in relation to geography teaching
Teaching methods: a. General; b. The primary age range; c. Secondary age range; d. Higher education; e. Field work and local geography; f. The use of maps; g. Textbooks; h. The use of other teaching aids
Geography teaching overseas
Geography in international understanding
Testing in geography

The bibliography is price £1.00 and may be obtained from the Geographical Association, 343 Fulwood Road, Sheffield S10 3BT.

20.25 A First Geography of the Eastern Caribbean, by F C Evans, price £0.55, published by Cambridge University Press, Columbus Publications Ltd, Trinidad, 1972

This is a paperback edition and it starts off by giving the position of the Eastern Caribbean, the volcanic and limestone islands and rainfall and vegetation. It then devotes a chapter on each of the islands in the Eastern Caribbean giving exercises at the end of each chapter. It is well illustrated with photographs and clear diagrams and maps.

20.26 16-19: Growth and response. 1. Curricula bases, Schools Council Working Paper No.45, published by Evans/Methuen Educational, price £0.65

This publication has as its subtitle 'Some suggestions for consideration from the Schools Council second sixth form Working Party with a discussion of the Certificate of Extended Education'. Historically it should be remembered that the first report suggesting modifications to the traditional A level courses in the United Kingdom was rejected by the Department of Education & Science and this report is a follow-up and further study of patterns of education in the sixth form. It considers the present patterns of the sixth form and the further education opportunities as an alternative to the sixth form and places great emphasis in recent trends on growth in the sixth form and growth in full-time further education. There is in addition consideration for growth in A level courses and comparable courses elsewhere. These are compared with growth in attainments. Those sixth formers following post-O level courses, but not following GCE A level courses, are considered as well as the growth in numbers of non-traditional sixth formers. It makes an attempt to predict future trends of development in the sixth form. In the second part of the report, headed 'The curriculum and examinations', the difficult problems of deciding how many subjects, what sort of subjects and who should enter the sixth form, are explored. The general component of education at sixth form level is considered in some detail as well as the relationship between the curriculum and the examinations and this section suggests the need for a sixth form leaving certificate. It then goes on to discuss what it calls the Certificate of Extended Education. As an example of the analysis and thinking going on behind the developments of further education in the United Kingdom this is a very valuable addition to the current literature on the subject.

20.27 Technical Education in Secondary Schools - Curriculum Paper 10, Scottish Education Department, published by HMSO, price £0.63

This publication is the outcome of a study undertaken by a Working Party with the following terms of reference:

> "To consider the curriculum in technical subjects in the secondary school in the light of recent trends and developments both within the subjects themselves and in the field of secondary education as a whole and to make recommendations."

The Curriculum Paper covers technical subjects as seen in the secondary school today in which it emphasises that the traditional skills of woodwork and metalwork have been joined by many other craft work activities in plastics and similar materials. Building drawing has taken its place beside technical drawing and skills associated with the construction industry and with car mechanics have found their way into the school workshop. This process of change is set against the technological society and its recent developments and against the educational system as it exists in Scotland. The particular remit covering the secondary school required the Party to relate the curriculum and technical subjects to that of secondary education as a whole and the Report fairly emphasises the need to provide balanced general education for children in which technical subjects were an element. The Report then divides its comments into sections covering the age ranges 12-14, 14-16 and 16-18. It makes a number of important recommendations, amongst which are that all boys and a great number of girls should be given the opportunity to become acquainted with technical education at the 12-14 age range and that the curriculum of all pupils from 15 onwards, not only those following the Certificate of Education Courses should include major and minor areas of studies as a mechanism for ensuring a broad balanced general education. The publication ends with an example of courses for the 14-16 age range.

20.28 The Human Environment: the British view, paper prepared on the occasion of the United Nations Conference on the Human Environment, Stockholm, 1972

The paper has been presented under 10 headings, as follows:

20.28.1 "Only one world to pollute" which gives The Agenda for Stockholm and The Public and Stockholm.

20.28.2 "The condition of Britain" which gives physical background; the legacy of the past; the pressure on land; water and finally the challenge which shows up the conditions as they now are and states the environmental challenge to the Government and the people of Britain with regard to pollution.

20.28.3 The Department of the Environment: a total approach. The policies of the DOE; urban problems and planning; transport pollution; structure of the Department; local government development; transport industries, housing and construction.

20.28.4 Local government and regional planning under the headings: The need for change; The Government proposals; Planning and regional policy; Regional problems; Promoting development.

20.28.5 The Housing Environment: home ownership; urban renewal; new towns.

20.28.6 Transport and the Environment: railways, roads, urban transportation planning.

20.28.7 Safeguarding our heritage: making the most of the countryside; agriculture; preservation; historic towns and buildings.

20.28.8 The fight against pollution: the World Commission; cleaning the air; purifying the water; cutting down noise; getting rid of waste; dumping at sea.

20.28.9 Looking to the future: international action; worldwide problems; population, the role of international organisations; Central Agency; Environmental Committee; marine pollution; monitoring.

20.28.10 Lessons - and hopes.

In the Appendix there are some recent official British publications on environmental matters and also maps showing the physical features/built up areas, annual rainfall and geology of Britain.

21. SCIENCE EDUCATION ABSTRACTS

21.1 Designing a Laboratory - 1, W H Lloyd, Education in Chemistry, Vol.9, No.4, July 1972, page 142

The problems associated with laboratory design and facilities are of continual concern to teachers in school and teacher training departments. Poor layout and facilities may adversely affect both staff and students. This is the first of a two-part article and attempts to review the development of laboratory design and outlines some of the main features which the author has evolved in designing various school and teacher training facilities. The article shows a series of possible laboratory lay-outs and traces historical attitudes towards these. To some extent the basic design has been influenced by the overall sizes recommended at various times in educational history. As the desire for greater and greater amounts of pupil practical work has increased, then the layout of the laboratory had to be altered to fit this requirement. Multi-purpose laboratories which are used for both class practical teacher demonstration and ordinary teaching also create special demands on the designer. Questions of economy of design must also be taken into account. For young teachers facing the problems of laboratory lay-out for perhaps the first time this article will provide some interesting food for thought.

21.2 Examining Chemistry at CSE Level, Dr G D Yeoman, Education in Chemistry, Vol.9, No.4, July 1972, page 129

When the Certificate of Secondary Education examinations were introduced in the summer of 1965 the danger, as well as the opportunities, were clearly recognised. The danger followed from the tendency for schools to concentrate on those aspects of, and approaches to, a syllabus which was most likely to yield good examination results. Thus to extend the influence of public examinations beyond the top 20% of 16 year-olds normally affected by O levels to the next 40% of the age group would increase the number of 16 year-olds affected by examination "backwash". The opportunities presented by the new examination followed from the chance to make a fresh start. It was hoped that "the outstanding characteristics of the examinations will be their freshness and vitality and they will reflect and not inhibit the originality of work being done in the schools". This article sets out to try and assess the extent to which these hopes have been realised in chemistry. It describes the three modes of examination at present being operated and pays particular attention to course work and assessment and the use of oral assessment and assessment of attitudes in particular. The basis of assessment in CSE chemistry examinations is being substantially broadened and the narrowing and restricting effects of the traditional three-hour paper are becoming less prominent.

21.3 Nuffield and the universities, L K Hamblin
The Nuffield scheme and its future influence, S Gordon Smith
Problems and rewards in teaching Nuffield A level, Dr Nora Lumb
Nuffield A level chemistry: a personal view, Roy Bailey
Education in Chemistry, Vol.9, No.5, September 1972, pages 171-178

As the Nuffield A level Chemistry scheme proceeds into wider dissemination in schools it is appropriate that Education in Chemistry should at this stage reflect some of the views of the scheme and the impact it is likely to have on other fields of chemical education. These four articles present four different aspects of the A level scheme. In the first article Mr Hamblin comments that with the changing attitude towards university education a two-fold problem for university teachers in the sciences arises. The motivation of the entering group is mixed and their pre-university education may have been conducted along unfamiliar lines. He suggests that Nuffield style university entrants have

received a mixed reception at the tertiary level. There is indeed considerable criticism amongst university staff about the lack of factual knowledge and a certain lack of rigour in the approach to concepts. The first criticism is not unexpected since one of the main features of the scheme has been to reduce the factual content to the essentials required for a proper understanding of chemical theory. A survey shows that the second criticism was by no means justified and there appeared to be no disadvantage in the grasp of theoretical concepts.

In the second article the orientation of the Nuffield Chemistry programme towards wider objectives than mere instruction in chemistry is stressed. Dr Lumb, in the third article, presents an article that will be of interest to any teacher attempting to tackle this sort of work at sixth form level. She points out that the Nuffield Projects are all concerned with action and she admits that relinquishing both traditional syllabus and traditional examination is certainly an upheaval and every upheaval is a potential problem. This however is the sort of problem that can be so easily turned into a reward. The article devotes itself largely to the practical problems facing someone teaching Nuffield A level. She points out some of the inherent rewards of the work. The rewards vary from the students' expressions of enjoyment to the fact that the teacher is very much involved in the assessment of the work. The author suggests that whatever else Nuffield A level chemistry does it gives someone something to think about, something worthwhile, be it student or pupil.

The final article in the group by Mr Bailey presents an experienced teacher's survey of the course as a whole. His points are by no means wholly complimentary but in balance he prefers it to a Board syllabus for several reasons. He feels the course is of an appropriate length, that the depth of treatment is fairly closely specified with an interesting range of experiments fairly well integrated into the various study units. He also stresses the innovations in the reading material, both in the students' books and such books as 'The Chemist in Action'. On the other hand he feels that organic chemistry has insufficient treatment, is insufficiently mechanistically oriented, and he is also unhappy with the presentation of thermo-dynamics but since this is a topic of considerable controversy anyway it is perhaps not surprising. The article provides interesting pointers for people wishing to study the scheme in depth and to make their own critical analysis.

Education in Chemistry is published by the Royal Institute of Chemistry and the Chemical Society in January and alternate months each year. The subscription rate is £5.00 per annum, single copies £1.25 and enquiries regarding subscriptions should be addressed to Chemical Society Publications, Sales Office, Blackhorse Road, Letchworth, Herts SG6 1HN, England.

21.4 Examining in Degree Courses, Journal of Biological Education 1972, Volume 6, No.5, pages 301-321

The following papers were given at an open meeting of the Biological Education Committee for Biologists from Polytechnics, Universities and Colleges held at the Royal Society on 15 May 1972.

The University of London Course unit Degree in Science, J E Webb
Continuous Assessment and Examining by the Open University, M E Varley
The Use of Multiple Choice Tests in Biological Teaching, J M Ashworth
Analytical Questions in Exams, A G Callely and D E Hughes
The Merits of Continuous Assessment and Formal Examinations in Practical Work, K W Thomas
Projects and their Assessment in Degree Examinations, J L Harper

This group of papers provide a fascinating insight into the developments taking place at present in the whole question of examinations at the tertiary education level. The authors ranging from the University of London, the Open University to Redbrick and Polytechnic Universities give an indication of the extensive discussion going on in this field in the UK at the present time.

21.5 Evaluation Studies of the Nuffield 'A' level Biology Trials. 4. School Characteristics and Achievement, P J Kelly, Journal of Biological Education, Volume 6, No.3, June 1972, page 197
Evaluation Studies of the Nuffield 'A' level Biology Trials. 5. Students after the Trials, P J Kelly, Journal of Biological Education, Volume 6, No.4, August 1972, page 259

These are 2 further reports on the Evaluation Studies of the Nuffield 'A' level Biology Trials (see SEN 19:21.3). In the first of these 2 articles the influence of a number of factors in the school-biology environment on achievement in Nuffield 'A' level Biology course is examined. These factors include teachers motivation, class size, facilities, types of schools and then proceeds to analyse these into the characteristics of high and low achieving schools. The consistency of the performance of high and low achieving schools is also examined. In the second of these 2 articles the final in the series of Evaluation Studies, students were looked at during the year after the Trials. The aim was two-fold, first to find out how the students viewed their experience of the Trials particularly in terms of understanding of the objectives of the work and the extent to which they considered the objectives were achieved. Secondly, to determine the pattern of their careers immediately after leaving school and any benefits or deficiencies that may have resulted from following the Nuffield scheme. An assessment of the understanding of objectives begins the article and a quick survey of careers entered is given. In the latter context it was considered that experience in the Nuffield 'A' level biology scheme was considered mostly beneficial.

The Journal of Biological Education is published six times a year for the Institute of Biology by Academic Press Incorporated (London) Ltd, subscription rates for overseas $10 plus $1.10 postage. Subscription orders may be placed with Academic Press Incorporated (London) Ltd, 24-28 Oval Road, London NW1 7DX, with the exception of those originating in the USA, Canada, Central America and South America which may be sent to Academic Press Incorporated, 111 Fifth Avenue, New York, NY 10003, USA.

21.6 On Teaching Problem Solving in Mathematics, by M Ruth Eagle and F R Watson, Mathematics Teaching No.59, Summer 1972, page 8

It is suggested that discovery methods may be used in two ways in mathematics, to teach content and to teach problem solving skills. A considerable debate exists at present as to the real values of discovery methods in teaching. Nevertheless, teaching mathematics by investigation may have a value in terms of motivation and the development of inter-personal relations which outweighs the considerable expenditure of time. In any case, imparting information is not the whole of teaching. If one aims amongst other things to promote ingenuity, resilience and independence of judgment, it is reasonable to suppose that these may be acquired by frequent experience of problem solving activities in which these qualities are exercised. The article goes on to discuss the relationships between discovery and information learning and ways in which the discovery approach can be used with children. Suggestions are given for operating the discovery approach, which include regular contact between teacher and student, encouraging students not only to solve the problems but to be aware of what aspect of its solution, such as framing a hypothesis etc they are engaged upon at any instant, and that students should be given more and simpler problems rather than a few difficult problems, thus illustrating a variety of approaches in the work.

Mathematics Teaching is published quarterly by the Association of Teachers of Mathematics, Market Street Chambers, Nelson, Lancashire, BB9 7LN, England and supplied free to members of the Association. The membership fee is £3.00 per year.

OVERSEAS ACTIVITIES

22. JAMAICA

The Journal of the Association of Science Teachers of Jamaica entitled 'Science Notes and News' appeared in July 1972 after a lapse of some years. This is the first issue in fact since 1966. The arrival of this journal, which will be of considerable value to the science teachers in Jamaica, has been made possible by a donation from Kaiser Bauxite Company. The price of this issue is 25 cents. It is hoped that further issues will appear shortly and that a wide range of articles will be included. Enquiries regarding the journal can be addressed to Mr H Gordon, Chairman of the Association of Science Teachers of Jamaica, Extra-mural Centre, Mona Campus, University of the West Indies, Kingston, Jamaica.

23. INDIA

Bombay

In the September edition of the Bombay Science Education Newsletter a report was given on the Workshop on Environmental Studies which was held in Bombay at the end of April 1972. This Workshop was held under the auspices of the British Council/CEDO and the Anglo-Indian Board of Education. Mr Meurig Evans of the National Museum of Wales (formerly of the Schools Council Environmental Studies Project), attended the Workshop for the purpose of acquainting teacher educators with the objectives and techniques of environmental studies and how they could be introduced into the educational system. Mr Evans also visited and conducted a course in Calcutta.

The Bombay Science Education Newsletter is published each month and contains information for local teachers on courses, conferences, films etc available in the area. It also provides an opportunity for teachers to exchange ideas and views in the correspondence section. The Newsletter is printed by the British Council, French Bank Building, Homji Street, Bombay 1.

INTERNATIONAL ACTIVITIES

24. The Second International Congress on Mathematical Education, Exeter, UK. 29 August - 2 September 1972

The Congress attracted 1,400 participant members and 300 associates from some 70 countries throughout the world. People interested in mathematical education at all levels - pre-school to university level - gathered to discuss common problems and share each others insights. The Congress, the second organised by the International Committee on Mathematical Instruction (ICMI), (the first was held at Lyon in 1969) met in Exeter under the chairmanship of Sir James Lighthill FRS to work within a framework arranged by a Programme Committee appointed by the British National Committee of ICMI. The Programme Committee, under the Chairmanship of Mrs Elizabeth Williams CBE, responding to the expressed wish of participants at the first Congress for a more active participation in the programme by Congress members, had arranged for 40 International Working Groups to meet during the course of the four days of the Congress. The working groups covered many different aspects of mathematical education and being smaller provided a useful opportunity for meeting people sharing similar "main" interests than would otherwise have been possible in a Congress of this size. The difficulty was to select the groups likely to be of most interest.

In addition to the Working Groups, National Presentations were made by some seven countries and displays were mounted by over 20 countries. There was also a programme of films and a book and equipment display.

Eight Plenary Sessions took place when distinguished lecturers drawn from seven nations had the opportunity to address the entire Congress. A report on the Proceedings is being edited by Mr A G Howson for publication by Cambridge University Press.

Arising out of the Congress ICMI is sponsoring solely or jointly eight specialised regional symposia on matters related to mathematical education; these symposia will report to the Third International Congress to take place in 1976 in a place to be decided - invitations having already been received from four countries to host the conference. The proposed symposia include conferences in Luxembourg and Hungary in 1973, Poland in 1974. Two more are to take place in tropical areas - one on the question of language and mathematics (a topic much discussed in the Working Group on "Mathematics in Developing Countries" and again pinpointed by Professor H W S Philip in his plenary address to the Congress on "Mathematics in the developing world: some teaching-learning problems"). It was strongly suggested in the working group and endorsed by ICMI that this conference should seek to involve both UNESCO and the Education Division of the OAU. Nairobi was suggested as a possible venue. A further conference on the theme "Curriculum Development with special reference to applications to development" was planned to take place in India.

Additional conferences in Japan and Copenhagen were announced and finally one involving the International Federation of Information Processing Societies (IFIPS) on the links between Mathematics and Computer Science in the school education. Some pressure for more interdisciplinary symposia was unsuccessful - though perhaps in 1976 the ICMI will be ready to consider sponsoring, jointly perhaps, more adventurous symposia aimed at breaking down barriers between disciplines.

Throughout the conference it was apparent that Hardy's "Here's to Pure Maths, may it never be applied" belonged to a former age and that mathematics

could only grow so long as it continued to be applied and to solve new problems; a reciprocal relationship was necessary for mutual health. This was the message in the Chairman's opening address with a plea that one should consider the key problem, that of the art of teaching and the art of applying mathematics and this seemed to provide a "text" for the Congress.

25. British Council International Course on Curriculum Development in Secondary Science, 3-16 September 1972

This course was held at the Centre for Science Education, Chelsea College, Bridges Place, London SW6. The Director of Studies was Dr A L Mansell, Lecturer in Education at the Centre for Science Education. Thirty people attended the Course and the following countries were represented:

Australia	Malaysia
Belgium	The Netherlands
Cyprus	Nigeria
Denmark	Norway
Germany	South Africa
Hong Kong	Spain
Iran	Sweden
Israel	Uganda
Kenya	Zambia

The aim of the course was to inform the members as to how curriculum development in secondary science had originated, been carried out and is still an on-going process in Britain. The course took the form of lectures and practical presentations from team members and teachers of Nuffield, Schools Council and Scottish Education Department, projects. A considerable amount of the course was also spent in the laboratories doing practical work from the projects to familiarise the course members with the materials. Sessions were spent on discussing methods for training science and mathematics teachers in the new curricula. The course was organised by the Science Education and Courses Sections of the British Council.

26. The teaching of technology in secondary schools: symposium - Council of Europe Committee for General and Technical Education

This symposium was planned as a direct follow-on to studies that have been taking place in a series of symposia and study groups within the Committee for General and Technical Education of the Council of Europe.

The picture for the current symposium was set in a number of documents and particularly one entitled 'The teaching of technology' edited by Monsieur Y Deforge from France, in which he says, "The advent of technical education is a real innovation in the teaching world. It is also something really necessary for there can no longer be any culture without technology. A person who is unable to decipher a technical drawing, express himself graphically, analyse a technical object, or make an informed judgment on the environment in which he lives, is uncultured. An educational system which will not accept technology is an educational system which turns out cultural cripples. This is now understood by all European countries. Numerous difficulties, however, are yet to be overcome. These are shared by all the countries considered and intensive research must lead to a precise definition of technical education and an evaluation of its effects. The training of teachers must be enlarged and space and equipment must be provided to include technology as a coherent element of an educational system."

The conference concentrated on the teaching of technology within the frame of the general education as distinct from technical studies that are associated

with technical and vocational education and training. The need to understand the "differentiation in technical education" was clearly stated at a symposium at Sevres in 1965 and a further meeting of a study group on technology in Strasbourg in 1966 and a meeting of experts in Frascati in 1967 revealed how difficult it was to find definitions acceptable to all European countries. The general statement of technical education that was agreed in substance by the group at Frascati says "Technical education is all education based essentially on the scientific observation, experimentation and application of man's modern achievements and of natural resources. It provides a new method of approach to humanistic studies and at the same time enables the pupil to acquire the necessary knowledge for the exercise of a profession." No such statement generally acceptable appears to have been possible about the meaning of 'technology' and it is interesting to remark that any attempt at a definition of technology is followed by a series of statements as to the interpretation. The paper edited by M Deforge is called "The Teaching of Technology" and contains descriptions of the teaching of technology in the Federal Republic of Germany, France, Italy, and the United Kingdom.

The aim of the current symposium was to explain and demonstrate the recent developments in school technology in England and Wales. Technology is not to be regarded as a separate school subject but as a combined activity involving science, craft and technical subjects as well as other disciplines. A second question was how relevant are United Kingdom developments to other European countries. It was hoped that the conference would produce guidelines for action in schools throughout Europe. The conference was attended by delegates from Austria, Belgium, Cyprus, Denmark, the Federal Republic of Germany, France, Greece, the Holy See, Ireland, Italy, Malta, The Netherlands, Norway, Spain, Sweden, Switzerland, Turkey and the United Kingdom. A report of the conference will be available in due course from the Council of Europe. The conference was organised for the Council of Europe by the Department of Education & Science and the British Council.

27. Seminar on Strategies for the Improvement of Education in Science & Mathematics

A seminar convened by UNESCO in co-operation with the United Kingdom National Commission for UNESCO and with professional technical and financial support from the British Council and the Centre for Educational Development Overseas, was held at the Centre for Science Education, Chelsea College of Science & Technology, University of London from 23 October to 4 November.

The objectives of the seminar were:

26.1 To share information on the latest developments on improvements in science education.

26.2 To share different experiences in the development of science education projects and in the institutionalising of science education improvement.

26.3 To compare experiences, implementation and reform in science education, particularly in such supporting activities as teacher education, cognitive development in children, evaluation and the application of educational technology including the development of science teaching equipment.

26.4 To consider methodology for, and to develop plans for further action in all aspects of science education improvement.

The participants in the meeting were mainly Directors or senior staff members of the science curriculum improvement projects or else scientists

actively concerned with the development of science education in their respective countries. The countries represented at the seminar were as follows:

Argentina	Japan
Australia	Kenya
Brazil	The Lebanon
Denmark	Malaysia
Egypt	Nigeria
Ghana	Philippines
India	Sri Lanka
Israel	Tanzania
Italy	Thailand
Jamaica	Venezuela

In addition to a full agenda concentrating on the latest developments and improvements in science education participants were requested to provide reports on the development and progress of science education in their respective countries which were presented to the participants at plenary sessions. From these presentations particular topics were identified for further discussion in general plenary sessions and other topics previously identified were discussed at special sessions at which the topics were introduced by participants or consultants. During the course the opportunity was taken to observe some science education improvement projects both at the Centre for Science Education in Chelsea and within Greater London. Various patterns for the development of science and mathematics education were considered and problems identified. Finally strategies and recommendations for future action were identified.

A full report of the seminar will be published by the Division of Science Teaching, UNESCO in due course.